GREENHOUSE GAS (GHG) EMISSIONS INVENTORY AND FORECAST: A CASE STUDY IN GREENSBORO

D R A F T

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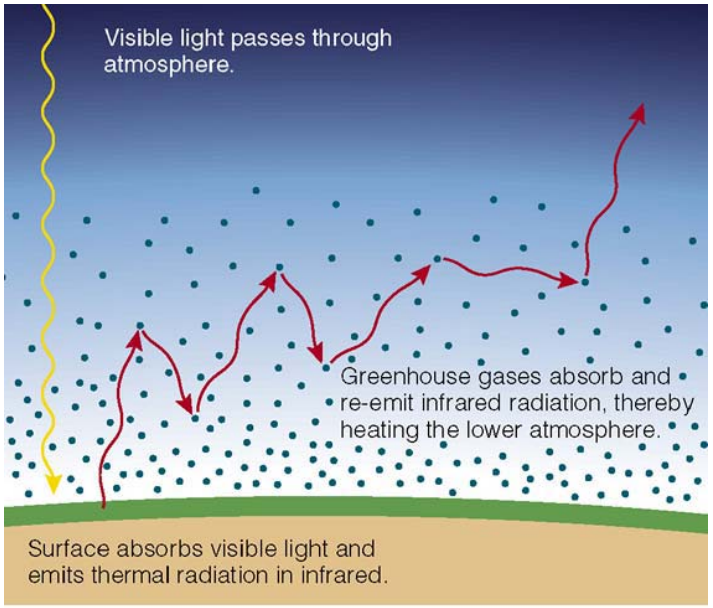
GREENHOUSE GASES (GHGs)

Greenhouse gases are those gaseous constituents both natural and anthropogenic—of the Earth's atmosphere that absorb infrared radiation emitted from the Earth's surface, the atmosphere, and clouds.



- These gases trap energy in the Earth's atmosphere and cause the *greenhouse effect*—the trapping of heat in the lower atmosphere—and influence the global climate.

- Water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are the primary greenhouse gases in the Earth's atmosphere.

Carbon Dioxide (CO_2) - A naturally occurring gas, which is also a by-product of burning fossil fuels, biomass burning, land-use changes, and other industrial processes is the principal greenhouse gas being emitted by human activities.

GREENHOUSE GAS EMISSIONS DUE TO HUMAN ACTIVITIES

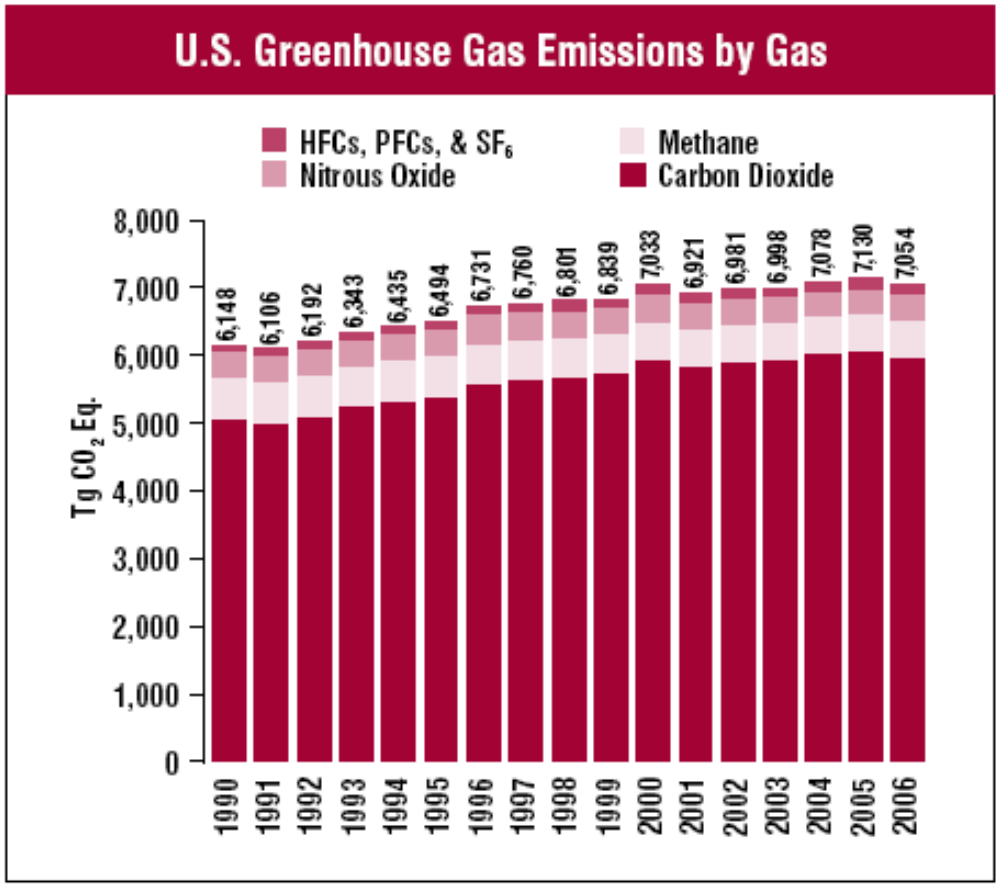
- ***CARBON DIOXIDE:*** Hydrocarbon (fossil Fuel) Combustion (power plant, transportation, oil-gas refinery, ……)
- ***METHANE:*** Livestock, manure, waste-water treatment, landfills and fuel production
- ***NITROUS OXIDE:*** Hydrocarbon combustion, industrial processes, denitrification of manure and soil nitrogen
- ***FLORINATED HYDROCARBONS:*** Refrigeration, dry cleaning, chemical manufacturing
- ***WATER VAPOR:*** Increased temperature from other GHGs

GLOBAL WARMING POTENTIAL OF GREENHOUSE GASES

GAS	*ATMOSPHERE LIFETIME (YEARS)*	*GLOBAL WARMING POTENTIAL (100 YEARS)*
Carbon Dioxide (CO_2)	50-200	1
Methane(CH_4)	9-15	25
Nitrous Oxide (N_2O)	120	298
HFC-134A	15	1,300
HFC-404A	>48	3,260
Sulfur Hexafluoride (SF_6)	3,200	23,900

UNITED STATES GHG EMISSION TREND (1990-2006)

- Emission are dominated by CO_2.
- Percentage of CO_2 slightly increases from 1990-2006
- The proportion of CO_2 is about 80% of the total emissions whiles the rest remains almost constant



Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2006

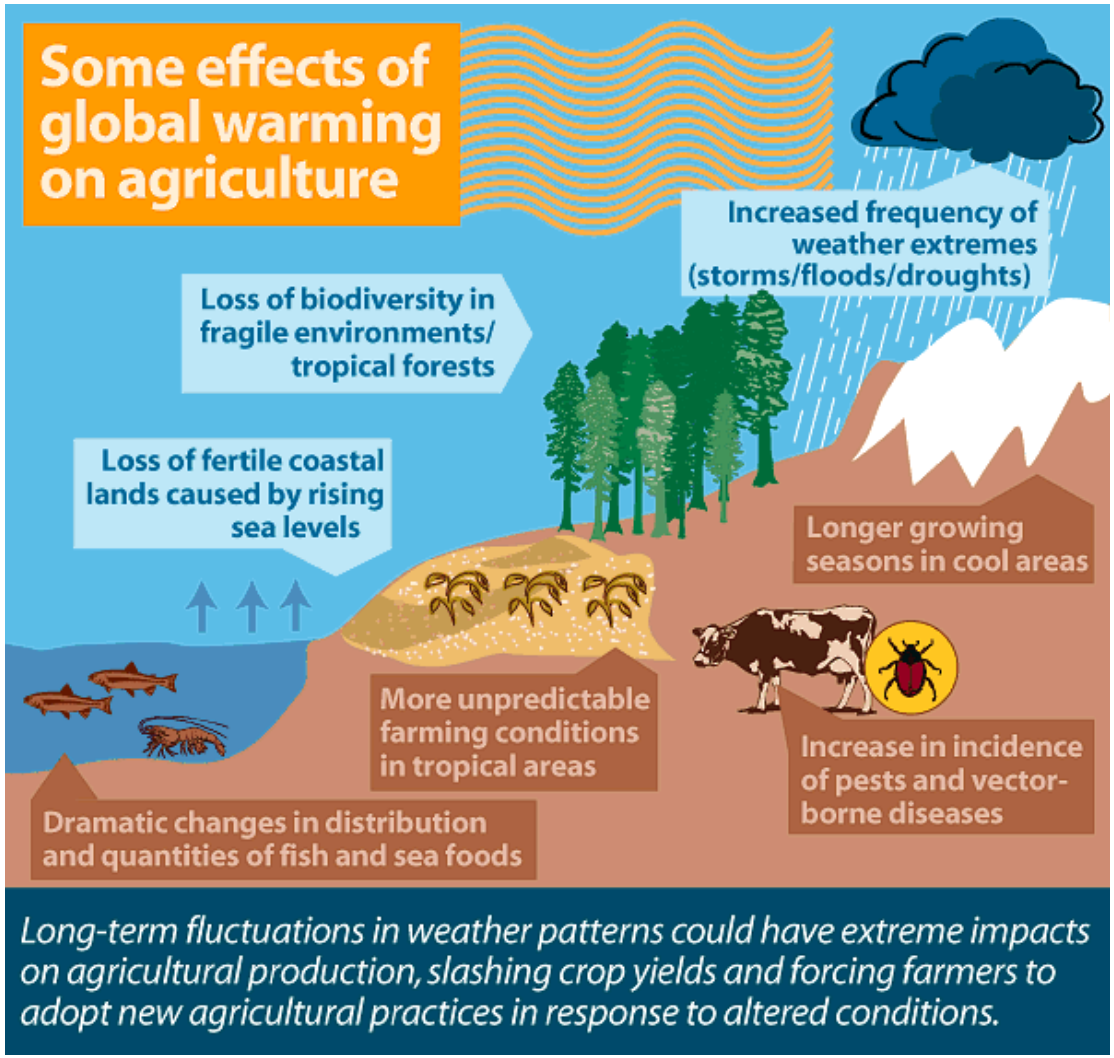
GHG AND CLIMATE CHANGE

- Human activities are responsible for the rise in GHG emissions and the consequential Global Warming.
- According to the current Energy Information Administration release greenhouse gases mostly carbon dioxide was up by 1.4 percent in 2008 as a result of human activities.
- IPCC "projects that unless urgent action is taken, global emissions in 2030 will be 25% to 90% higher than today" this will result in unprecedented change in the global climate condition.
- The earth's mean surface temperature is forecasted to increase from 1.4°C to 5.8°C (IPCC, 2002)

- *IPCC WARNING: To stabilize the average global warming to 2°C beyond the pre-industrial level by 2050 will require 50% cut in current levels of greenhouse gas emissions*

EFFECTS OF CLIMATE CHANGE DUE TO GHG EMMISINS

- Human health,
- Agriculture,
- Natural ecosystems,
- Coastal areas,
- Settlement



METHODOLOGY FOR GREENSBORO GHG INVENTORY (ICLEI, CACP)

OVERVIEW OF CACP'S CAPABILITIES

- Create GHG and criteria air pollutant emissions for base year
- Forecast and back-cast emissions growth
- Evaluate measures to reduce emissions
- Prepare emissions reduction action plans

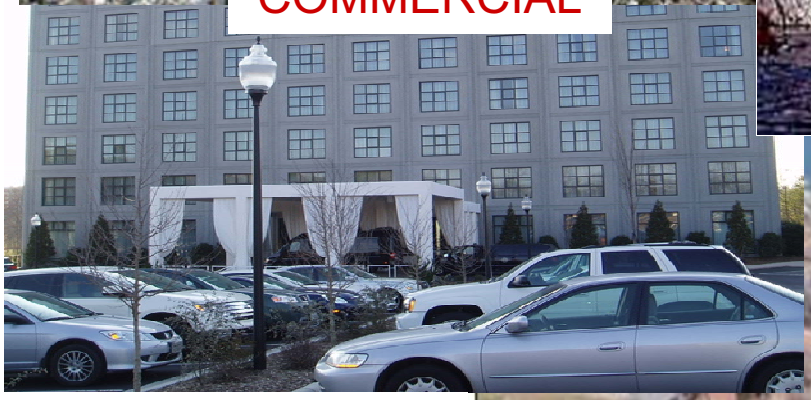
GREENSBORO GHG INVENTORY DATA SOURCE

CATEGORIES OF DATA

- **Residential**
- **Commercial**
- **Industrial**
- **Transportation**
- **Waste**

WASTE

COMMERCIAL



TRANSPORTATION

INDUSTRIAL

GREENSBORO INVENTORY DATA COLLECTION FOR THE BASE YEAR 2007

***NATURAL GAS*: Piedmont Natural Gas**

***ELECTRICITY*: Duke Energy**

***TRANSPORTATION*: NC Department of Natural Resources**

***HOUSEHOLD NUMBER*: Piedmont Triad Council of Government**

WASTE DATA: City of Greensboro Environmental Service Dept.

***CENSUS DATA*: Piedmont Triad Council of Government**

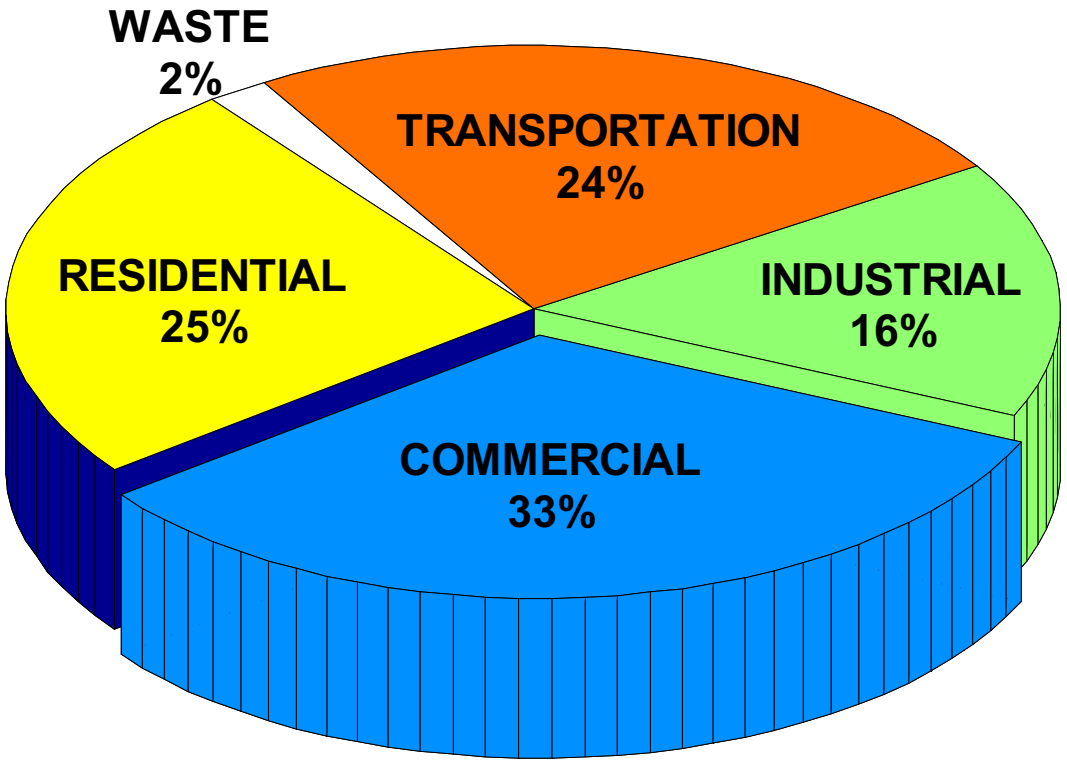
NUMBER OF COMMERCIAL EMPLOYEES:????

NUMBER OF INDUSTRIAL EMPLOYEES:????

ENERGY CONSUMPTION BY SECTOR AND GHG EMISSIONS FOR BASE YEAR 2007

SECTOR	*ENERGY (MMBtu)*	*EQUIV. CO_2 (tons)*
Residential	11,220,796	1,518,291
Commercial	12,551,659	1,999,662
Industrial	6,920,866	962,413
Transportation	17,328,166	1,485,117
Waste	NA	115,844
Total	48,021,487	6,081,327

PERCENTAGE GREENSBORO GHG EMISSIONS BY SECTOR FOR BASE YEAR 2007



CRITERIA AIR POLLUTANT EMISSIONS BY SECTOR FOR BASE YEAR 2007

SECTOR	*NO_X (tons)*	*SO_X (tons)*	*CO (tons)*	*VOC (tons)*	*PM10 (tons)*
Residential	2,390	6,372	277	44	138
Commercial	3,170	9,440	323	46	194
Industrial	1,719	4,356	240	36	97
Transportation	4,835	270	39,408	4,038	135
Total	12,114	20,438	40,248	4,163	565

CRITERIA AIR POLLUTANT EMISSIONS BY SOURCE FOR BASE YEAR 2007

SOURCE	NO_X (tons)	SO_X (tons)	CO (tons)	VOC (tons)	PM10 (tons)
Diesel	1,632	72	1,348	182	63
Electricity	5,901	19,896	477	53	386
Gasoline	3,202	198	38,061	3,855	72
Natural Gas	1,378	272	363	72	44
Total	12,114	20,438	40,248	4,163	565

RESIDENTIAL SECTOR: BASE YEAR 2007 ENERGY USE, CAP&GHG EMISSIONS

Residential	*Energy (MMBtu)*	*NO_X (tons)*	*SO_X (tons)*	*CO (tons)*	*VOC (tons)*	*PM10 (tons)*	*GHGs (tons)*
Electricity	5,456,746	1,884	6,352	152	17	123	1,162,175
Natural Gas	5,764,050	506	19	125	27	15	356,116
Total	11,220,796	2,390	6,372	277	44	138	1,518,291

COMMERCIAL SECTOR: BASE YEAR 2007 ENERGY USE, CAP&GHG EMISSIONS

Commercial	*Energy (MMBtu)*	*NO_X (tons)*	*SO_X (tons)*	*CO (tons)*	*VOC (tons)*	*PM10 (tons)*	*GHGs (tons)*
Electricity	8,096,659	2,796	9,425	226	25	183	1,724,422
Natural Gas	4,455,00	374	15	97	21	11	275,240
Total	12,551,659	3,170	9,440	323	46	194	1,99,662

INDUSTRIAL SECTOR: BASE YEAR 2007 ENERGY USE, CAP&GHG EMISSIONS

Commercial	*Energy (MMBtu)*	*NO_X (tons)*	*SO_X (tons)*	*CO (tons)*	*VOC (tons)*	*PM10 (tons)*	*GHGs (tons)*
Electricity	3,537,277	1,221	4,118	99	11	80	753,367
Natural Gas	3,383,589	497	238	141	25	18	209,046
Total	6,920,866	1,719	4,356	240	36	98	962,413

TRANSPORTATION SECTOR, BASE YEAR 2007 ENERGY USE, CAP&GHG EMISSIONS

Transportation	*Energy (MMBtu)*	*NO_X (tons)*	*SO_X (tons)*	*CO (tons)*	*VOC (tons)*	*PM10 (tons)*	*GHGs (tons)*
Gasoline	14,336,617	3,202	198	38,061	3,855	72	1,225,462
Diesel	2,991,549	1,632	72	1,348	182	63	259,655
Total	17,328,166	4,835	270	39,408	4,038	135	1,485,117

REMAINING WORK

- Forecast and back-casting Emissions growth
- Evaluate measures to reduce emissions growth
- Prepare emissions reduction action plans

ADDITIONAL DATA NEEDED

- Number of commercial institutions for the base year and the estimated growth rate
- Area commercial institutions for the base year and the estimated growth rate
- Number of commercial employees for the base year and the estimated growth rate
- Number of industrial institutions for the base year and the estimated growth rate
- Area industrial institutions for the base year and the estimated growth rate
- Number of commercial employees for the base year and the estimated growth rate

THANK YOU !!!